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Europe/International

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AEROSPACE

ESA's Engstrom on Ariane 5 Launcher

BR1210142594 Paris ARIANESPACE NEWSLETTER
in English Oct 94 p 3

[Interview with ESA Director of Launchers Fredrik Engstrom; place and date note given: "An Interview with Mr. Fredrik Engstrom, Director of Launchers—European Space Agency (ESA)"]

[FBIS Transcribed Text]

[ARIANESPACE NEWSLETTER] Do you think that the Ariane 5 launcher is well adapted to today's space market needs?

[Engstrom] There are usually 25 to 30 years between launcher design and the end of the operational phase. We are therefore coming to the end of the Ariane 4 family, but Ariane 5 will still be here in 2020.

I think that Ariane 5 will be the most modern and efficient commercial launcher in the world. Its performance certainly meets near-future market needs, as do its other aspects: reliability, production and operational simplicity and recurrent costs. Ariane 5 is indeed a big improvement over Ariane 4, as well as a big improvement over competing launchers.

Remember, too, that the Ariane family was designed to respond to a political requirement: Europe's unrestricted access to space. At the time, nobody dared to mention any commercial goal. It turned out that the commercial strategy was extremely successful. Today, we still have the same political requirement, but commercial success has become almost equal in weight, because it guarantees Europe's access to space at minimum cost.

Finally, we must take into account the fact that the market is in constant evolution. One can discuss conclusions of different market surveys as to the mass and size of telecom satellites. The key to success for Ariane is to maintain double launch capability, and if we look at what the competition is doing, we know that Ariane must have twice that performance. When we study both market evolution and the competitors' programs, we see that the performance target for the Ariane 5 evolution program is in fact well balanced.

[ARIANESPACE NEWSLETTER] With its launch service experience, Arianespace believes that it should naturally be the space transportation operator for Europe's future space program: space station modules, manned flights, etc. What is your opinion?

[Engstrom] I think that a very fundamental part of potential European participation in the international space station program will be Ariane's role in servicing the space station—i.e., supplying fuel, non-pressurized equipment, etc. There should be a need for an average of one to two Ariane 5 launches per year, with very distinct functions which are being defined today.

I believe that ESA will play a role in logistics planning of the program, which also involves Americans, Russians, Canadians and Japanese. In Europe, then, we will need an organization to carry out launch operations. And I assume that it will be Arianespace, as it is today—it's a natural role for Arianespace. The exact interface between the different organizations is yet to be defined, but everyone will have a role to play. For manned flights, it's the same thing, but obviously this will come later than unmanned flights.

[ARIANESPACE NEWSLETTER] Europe has successfully invested in the Ariane program, set up an industrial structure and created jobs. To preserve these results in the face of unchecked telecommunications deregulation, what would your recommendations be to space users and manufacturers?

[Engstrom] Space users must realize that they enjoy stable access to space. To preserve this, they need to be careful not to jeopardize the future market by being too short-sighted. Obviously, in the future, as well as today, one should have more than one launch service operator. But I don't think anyone would disagree that Arianespace is almost alone in providing services of such quality. Of course, if Arianespace, or any other operator, is to maintain high performance and quality services, its customers must demonstrate some loyalty. This is not specific to the launcher business: it's also true for a grocer who buys apples every day for his customers—if he changes suppliers too often, he will not be able to guarantee that one day his apples will not be rotten. Business is business, but a certain degree of loyalty and respect is always necessary for good, long-term business relationships.

This concern for loyalty and respect also applies to manufacturers. One may sometimes find a short-term solution for a project or two, but what next? Also, industrial companies have a highly sensitive relationship which can very easily be disturbed: if one of the links disappears, the whole chain goes.

[ARIANESPACE NEWSLETTER] In advance of the next major European decisions on future space programs, could you tell us about the main lines of ESA's strategy as they are being defined today?

[Engstrom] I would like to limit my answer to the field of launchers. We hope that governments will decide to maintain political support for Ariane 5, as they did for Ariane 4. We will also of course propose the Ariane 5 evolution program and other activities, in order to take the future market into account. By then, there will also be strong indications as to the space station "market" for Ariane 5. So we aim at obtaining a decision to maintain Europe's industrial capability and technology in the field of launchers.

We are also discussing the future: new launchers, new concepts, new engines, in an ongoing study program. The present program stretches to 1996, and we must see what the next steps will be.

Our permanent goal is to maintain Europe's unrestricted access to space and launcher technology.

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France: Fourth Ariane-5 Booster Test A Success*BR0610113594 Paris ESA PRESS RELEASE
in English 30 Sep 94 p 1*

[Unattributed report: "Fourth Test on Ariane-5 Booster Goes Well"]

[FBIS Transcribed Text] Paris 30 Sep—The fourth test on a P230 solid booster for the European Ariane 5 launcher took place on Friday 30 September 1994 at 13h05, Paris time [1205 GMT], on its test stand at the Guyana Space Centre, the European spaceport at Kourou in French Guyana.

This test follows three previous tests: The B1 with the booster in "heavy" configuration on 16 February 1993, the M1 on 25 June 1993 which was the first test with the booster in "near-flight" configuration, and the M3 on 20 June 1994 in "flight" configuration. The M4 test also in "flight configuration" included a flight-type actuation system and lighter thermal protection. Three more tests are foreseen before the maiden flight of Ariane 5 (Ariane 501).

The first indications are that the test went well.

The Ariane 5 launcher will be fitted with two P230 boosters, each 30 mt high and containing 237 tonnes of propellant grain in three segments. Each booster has a thrust of 540 tonnes (equal to that of the most powerful Ariane 4 on lift-off), which makes it the most powerful booster ever built in Europe.

This test was run under the responsibility of EURO-PROPULSION (a firm owned by BPD Difesa e Spazio [Defense and Space] of Italy, and the French Societe Europeenne de Propulsion [European Propulsion Company]). CNES (the French Space Agency) designed the test-stand and was in charge of carrying out the test.

The P230 solid booster forms part of ESA's Ariane 5 programme, the prime contractorship of which ESA has delegated to CNES.

France: Ariane-5 Storable Propellant Stage Test Successful*BR1710085594 Paris ESA PRESS RELEASE
in English 14 Oct 94 p 1*

[Unattributed report: "Successful First Long Duration Test of the Storable Propellant Stage"]

[FBIS Transcribed Text] Paris 14 Oct—The Ariane 5 storable propellant stage (EPS) (the EPS stage—height = 3.3 mt, diameter = 4.0 m—is propelled by the Aestus engine—thrust = 27.5 kN—. This turbopumpless engine consumes, in vacuo, in 1130 seconds, a mixture of 3.2 metric tons of monomethyl hydrazine and 6.3 metric tons of sodium tetroxide), developed by DASA (German Aerospace Company), successfully passed a first long duration firing test (1075 s) on the 5th of October at the Lampoldshausen test stand.

The Aestus engine, which equips this stage, has itself passed a number of firing tests representing 12,000 cumulated operating seconds, including very long duration firings (1380 s), as well as in vacuo firings. The EPS stage, located in the launcher upper part, is primarily in charge of placing launcher payloads in geostationary transfer orbit. Its nominal operation is approximately 1100 seconds.

The EPS stage is part of ESA's Ariane 5 programme, the management of which has been delegated to CNES [National Center for Space Studies].

France: Future Large Aircraft Becomes Airbus Program*BR1410162894 Paris AIR & COSMOS AVIATION
INTERNATIONAL in French 9 Sep 94 p 33*

[Article by Andre Breand: "The Future European Military Transportation Aircraft Becomes an Airbus Program—By Going Under Airbus' Wings, the FLA Reinforces Its Competition Position With UK's C-130J Aircraft"]

[FBIS Translated Text] The European Future Large Aircraft (FLA) program has taken another step toward completion. It has also reinforced its credibility in the face of competition by the U.S. firm Lockheed to market its C-130J cargo aircraft in Great Britain. The four Airbus Industries' partners (Aerospatiale, British Aerospace, CASA [Spanish Aeronautical Engineering Company] and DASA [German Aerospace Company]) have effectively decided to integrate this program within the structure of the EIG [Economic Interest Grouping]. A specialized subsidiary, with Airbus Industries and the other Euroflag Consortium partners (including Alenia) as the main shareholders, will be created. According to the European partners, "its mission would be to manage the project to ensure that the FLA enters into operation in 2002."

This change in status for the FLA will give new impetus to the project. If developed as part of the Airbus program, it will benefit from the consortium's wide experience in the construction of civil aircraft. As large aircraft for military use largely resemble civil aircraft, it is clear that the FLA will benefit from the manufacturing, industrial management and cost reduction expertise developed by Airbus Industries. "With Airbus's system of industrial management, fears that the program will drift like the Eurofighter program are fading," an official from Euroflag said. Further, according to a separate parliamentary report, this management style should lead to an estimated 12-percent saving on the FLA and limit its development costs to 26 billion French francs [Fr] for a unit price of Fr380 million.

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Given this solid backing, the FLA dossier gains new credibility in the face of criticism by supporters of the C-130J. The agreement also comes at a time when the purchasing officer at the British Defense Ministry, Malcolm McIntosh, is strongly criticizing the setting up of a civil structure for the FLA. These criticisms come in addition to previous critiques he made on the direction of the program and the definition of the aircraft. He indicated that, to date, only the width of the fuselage had been definitively fixed. That was not sufficient a criterion to persuade the English to order the FLA, he said.

In other respects, Air Chief Marshall Sir Patrick Hine announced on 5 September at Farnborough that the Royal Air Force was seriously thinking of ordering a first series of 30 Lockheed C-130Js to be delivered in 1996, and would complete its fleet with the FLA.

Forty-One Billion Francs for the United Kingdom

Lockheed is forcing the issue politically by confirming that the Hercules is being offered at a firm and definitive price and that the British treasury will not need to call on taxpayers to finance the C-130Js.

The C-130J is being offered at a unit price of Fr137.5 to Fr165 million, or an initial contract including technical support and spare parts worth an overall Fr7.92 billion. According to British officials from the UK Support Group of 36 British industrialists, which groups together Dowty, Lucas, GEC, Hunting, Westland and Shorts, it would generate work for 3,500 employees in the British aeronautics industry and a turnover of Fr18.7 billion as of 1996. British Aerospace [BAe] says this figure would be closer to Fr6.6 billion.

In response to these arguments, BAe says that its participation in the program, in other words the design and production of the wing, would mean work for 500 engineers and technicians and over 2,000 employees. The FLA would also enable BAe's design office to hold on to its expertise on wings. If it decides not to participate in the program, some Fr41 billion and 7,500 people could be concerned.

For Dick Evans, BAe Chairman, "it is unthinkable not to participate in this important program." This is also the view of engine maker Rolls-Royce which has just announced its participation with SNECMA [French National Company for Aircraft Engine Studies and Construction] and its German and Italian partners in the development and production of the engines.

According to one official, the British government has decided to postpone its final decision until the spring of 1995. This will give the Euroflag organization time to respond in detail to the four questions asked by the Ministry of Defense's services on the program's management, exact specifications, calendar and the prices. "The future European military large aircraft will be built with or without the British," Louis Gallois, Chairman of

Aerospatiale, said emphatically. The FLA program will be well and truly designed and produced under the responsibility of Europe's major civilian planemaker.

Germany: Use of Minisatellites for Scientific Purposes Described

94WS0519A Duesseldorf VDI NACHRICHTEN
in German No 34, 26 Aug 94 p 10

[Article by Manfred Ronzheimer: "Minisatellites Serve Science. German Universities Operate Their Own Research Satellites in the Universe"]

[FBIS Translated Text] Scientific minisatellites, which in most cases fly along in the cargo bay as "fellow travelers" at the time of launching of large boosters, are earning their place in Earth orbit. In Germany the research institutes are the pacemakers of a new generation of satellites.

The Berlin Technical University already has two and Bremen University has one minisatellite in orbit. The Potsdam Georesearch Center early in 1995 will become the first major German research institute likewise to acquire an artificial moon of its own and the East German technical companies, in which GDR space research researchers have made themselves independent, are developing on the order of the Bonn Ministry of Research an "NBL-Sat" (Neue Bundeslaender-Sat—New Federal States Satellite) for remote sensing purposes.

Certainly good and bad luck go hand in hand in space, as the most recent experiences demonstrate. While the most recent German university satellite, the "Bremsat," is functioning free of trouble and since its launch early in February 1994 has been supplying good scientific results, the second Berlin satellite, Tubsat-B, which a week before with Russian help had been sent into the heavens, meanwhile once again became inoperative.

What happened in earth orbit on 5 March 1994 is for the Technical University (TU) satellite researcher, Udo Renner, still a mystery. Up to that time the Tubsat-B, 50 kg in weight, put into orbit on 25 January, had performed its mission faultlessly. Between one revolution, which lasts a total of 110 minutes, and the next all contact was broken off. The reasons for the blackout remain unexplained. "We simply are receiving no more telemetric data from which we could draw conclusions as to what the defect might be," says Professor Renner.

Certainly already a few days after Tubsat had been positioned in its polar orbit at an altitude of 1200 km together with a Russian weather satellite, a radio transmitter on the Uni-satellite gave out. However, communication could be reestablished by programmed commands from the ground.

Now the Berliners once again are directing their space pride to the veteran Tubsat-A, which has moved in its trajectory in the heavens since July 1991 and as before is

functioning without problems. Udo Renner is very satisfied with the yield from the long-term scientific experiment aboard this satellite revolving at an altitude of 800 km, whatever the degree of degradation of the solar cells may be. Initially it had been assumed that the silicon and gallium arsenide solar cells under the impact of hard space radiation would be degraded at the rate of about 3.5 percent per year and worsen in their performance. "We have now established that this degradation is only 1/2 to 1 percent per year," reports Renner. "That is in itself a scientifically interesting result." The Berliners also have gained new knowledge due to the long-term high performance of the integrated construction components and batteries.

The Bremen satellite specialists of the Center for Applied Space Technology and Microgravitation of Bremen University (Zarm) have had a narrow escape with a "blue space eye." Shortly after the launch on 3 February with the American Space Shuttle Discovery, the "Bremsat" with a weight of 63 kg and a diameter of 50 cm had disappeared without a trace in its orbit at an altitude of 3356 km.

The Bremen space technicians looked for it for a week. "We thought at first that something had gone catastrophically wrong," reports Hans Koenigsmann of the Zarm team. "Later it was established that we probably had a software problem because a high-energy particle had penetrated into the satellite." No damage was caused thereby. With persistent signals the Bremen specialists managed to put their earth satellite back on line.

The next scientific satellite candidate is the Georesearch Center in Potsdam, which will be the first German major research institute which will have its own minisatellite. The mission of the laser satellite, 30 cm in diameter, is to make measurements of the Earth's gravity field. It will be built by the Kayser-Threde aerospace company in Munich.

Within a half-year the satellite, with a weight of 30 kg, should be ready with the participation of a Russian supplier and then with a Russian Progress booster will be carried to the Mir space station, from whence it will be put into a low orbit. The Potsdam Research Center must pay a total of 1 million German marks [DM] for the GFZ-1 satellite, a sum which also includes the launch cost.

The project for a minisatellite which is to be built by the aerospace companies in the new federal states for use in the new federal states will also be made more specific. Just now the German Aerospace Agency, DARA, has given the green light for the DM50-million project. The project will be directed by the FPM Space Sensor company in Freiberg in Saxony, set up by space researchers from the former GDR Carl Zeiss Jena combine.

"It should be a minisatellite in the range from 100 to 500 kg," says Klaus Meyer, FPM company director, in explaining the project, and will perform in space under

the designation "Frei-Sat" (Freiberg Satellite), corresponding to the company name. With this size it also will be able to carry instruments which will be installed for the sensing and monitoring of phenomena in East Germany. "This will later also be internationally marketable," hopes Meyer. "But we initially wish to create a technological innovation in the new federal states for solving the problems prevailing in these new federal states."

Germany: Virtual Reality Used to Control Robots for Space Missions

94WS0509B Frankfurt/Main FRANKFURTER
ALLGEMEINE in German 31 Aug 94 p N3

[Article by Joerg Berendsmeier: "With Virtual Reality in the Universe. Highly Promising Remote Control of Robots"]

[FBIS Translated Text] The black TV screen scope, the "Eyeophone," gives a free look into the interior of a space station. With the aid of a so-called "data glove," objects in the immediate neighborhood are moved and an artificial hand wanders through the space scenery. This picture is no clip from a science fiction film. Engineers from a consortium of intermediate-sized enterprises, together with the Institute for Robot Research at Dortmund University, have succeeded in making serviceable a virtual reality technology, an artificially created world behind the computer screen, for the control of robots in unmanned spaceflight.

The vision which Eckhard Freund and his collaborators at the institute have is a free-flying system which repairs satellites, supplies them with new energy, or in case of necessity puts an end to them. The idea behind the new "Vital" system was an improvement in the "man-machine" performance of remote control of robots in space work. The previously customary control by cameras or so-called joysticks from a ground station was susceptible to problems and the system was definitely difficult to operate. The institute was able to gain the first experience during the German Spacelab-D2 mission.

The heart of the "Vital" is a display scope which conveys to the user three-dimensional pictures which are dependent on his particular direction of view. A data glove is connected with this scope, which the wearer by finger movements alone can move in artificial space. By means of this virtual reality an impression will be conveyed to the user and he performs a hand grip or an experiment in true space work. The experiments which are performed in the artificial world, for example, shoving a palette with a test tube into an oven, are then executed by robots in space on a delayed basis.

Three years ago the German Aerospace Agency (DARA) and the North Rhein-Westphalian Ministry of Technology authorized a joint-stock consortium of aerospace-oriented enterprises to investigate virtual reality for

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telerobotics. Within the project, with a price tag of 5.5 million German marks, the basic usefulness will be demonstrated before the robot work of the Dortmund Institute is invoked. After further research the system should be offered to the European Space Agency, ESA, and be tested in space. Hans J. Classen, the project director, states that there is no one who offers a comparable technology.

Germany: Experimental Work on Horizontally Launched Spacecraft Reported

94WS0526D Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 19 Sep 94 p 10

[Article by sel: "Aachen Scientists Work on Foundations for Horizontally Launched Spacecraft"]

[FBIS Translated Text] Aachen—The foundations for the design of spacecraft, which are able to take off and land horizontally like a normal aircraft, are being worked on at Special Research Area [SFB] 253 at the Rhine-Westphalian Institute of Technology in Aachen. In contrast to rockets they are reusable and equipped with air-breathing engines, which take the necessary oxygen for fuel combustion from the atmosphere. Until now there have only been vertically launched space transporter systems with very large, multi-stage rockets as starting systems. These are lost once they have fulfilled their function. The weight is particularly great, since rocket propulsion must carry with it fuel and oxidizer—for example hydrogen as fuel and oxygen as oxidizer.

Such reusable transport systems are currently being conceived by the leading industrial nations as single- or two-stage spacecraft. For the two-stage ones the horizontally launched spacecraft initially carries the actual space ship on its back to an altitude of 30 kilometers. At a flight speed of about seven or eight times the speed of sound, the second stage detaches itself from the carrier spacecraft and from then on takes its payload into orbit using its own rocket drive, while the carrier spacecraft returns to earth. This flying takeoff procedure is a difficult maneuver, the feasibility of which could only recently be successfully simulated with high-speed computers. Experiments that were carried out in the meantime have confirmed that the simulation was correct.

One of the most important tasks of Special Research Area 253 consists of the theoretical-numerical and experimental study of the flow field around the spacecraft for the entire speed range from launch to maximum speed. The topic for SFB 253 is deliberately restricted to researching the external aerodynamics. The aerial forces (lift and drag) and other moments occurring near a spacecraft are reported by means of wind tunnel experiments and theoretical studies. In addition, local pressures, heat transfers and speeds are measured and the flows made visible. In two other special research areas in Munich and in Stuttgart, flight path calculations and engine designs as well as reentry problems are being worked on.

These projects encompass the most important problems. Greater efforts, particularly to research the propulsion technology, must be undertaken for a detailed design. The problems which occur in combustion are now being studied in Japan, the United States and France with much greater involvement than in the FRG, the Aachen researchers say. In Aachen the Institute for Aviation and Space Flight, the Aerodynamics Institute, Lightweight Construction, Jet Engines and Turbo Engines and the Institute for Electrical Engines in Space Flight and others participate in the SFB. The required coordination by the academic institutions and institutes for this ambitious goal is considerable. For the design of a spacecraft a mission concept must initially be worked out, from which a prototype configuration can then be derived. The prototype configuration, which was drafted for SFB 253, carries the name ELAC 1. That is intended as an abbreviation for Elliptic Lift Concept. It is binding for all three special research areas. Should this concept be built, the large-scale construction will be about 70 centimeters long.

The ELAC 1 prototype configuration by the special research area in Aachen (spokesman is Professor Egon Krause) has meanwhile met with interest in the scientific world. It has been measured in seven wind tunnels in the FRG so far. Fourteen models in various scales are being built for the experiments and, depending on their specific use, equipped with sensors. The test data acquired from the many measurements have now been selected in Europe as a test case for checking calculation methods. The institutions involved are: The Aachen Institute of Technology with its separate institutes, Duisburg University and DLR [German Aerospace Research Institute] Cologne with its institutes for propulsion technology and the main department for wind tunnels. Since spacecraft today can no longer be designed without taking the effects on the environment into consideration, the German Research Association requires a focal program, in which the effects of aviation and space flight on the atmosphere are studied.

The flight of a spacecraft in the lower atmosphere at low speeds results in a major heating of its surface, which can lead to material deformation and pyrolysis phenomena primarily on the head and on the front edges of components of the flying equipment. But this intense surface heating also has an effect on the thickness and nature of the wall boundary layers, which in the return phase affect the aerodynamic flight properties until landing.

Similarly large thermal loads and flow influences result for air-breathing propulsion systems in the inlets in the combustion chamber (up to 3,000 degrees for hydrogen combustion) and in the jet nozzle. The best possible passive and active cooling systems are just as necessary as a structural form of construction which must stand up to the high thermal stresses through greatly varying temperatures. These lead to chemical and thermodynamic changes in the passing air, which are described as deviations from the equilibrium state. They occur

mainly during sudden, powerful changes in the condition from jerky compression and expansion waves. The air streaming by the spacecraft cannot completely adapt to these changes in condition. Certain properties, for example the chemical composition of the air and the thermal excited state of a polyatomic gas, need time in order to achieve a new state of equilibrium adapted to the altered surrounding conditions. Accordingly, the changes in condition and the transportation processes of mass, impulse and energy taking place in the flow therefore, usually temporarily, no longer take place in equilibrium.

The research which will be reflected in dissertations, is concentrated to the physical foundations of the nonequilibrium flows, the impulse and heat transportation in the wall boundary layers and the development of mathematical models and numerical integration methods.

AUTOMOTIVE, TRANSPORTATION

Germany: Laser Scanner Developed to Measure Large Workpieces

94WS0526A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 14 Sep 94 p 8

[Article by Peter Winandy: "Scientists in Aachen Develop Laser Light Scanner for Measuring Large Workpieces"]

[FBIS Translated Text] Aachen—In manufacturing very large vehicle bodies such as for busses and rail vehicles, the criteria for quality evaluation are variously defined, at least in partial areas, compared to a not predetermined workpiece such as a rounded, wind tunnel-optimized automobile body. The key words of "straightness" and "evenness" are given particularly great importance in the final control of large vehicles up to 28s meter in length. While the checking of the body has so far been carried out in a time-consuming way with guide line, measuring tape and straight edge by measuring columns with an average of three trained professionals, a measuring device based on a rotating laser beam will now take over these jobs faster and more reliably.

The Lassca sensor system was developed by the European Center for Mechatronik (Reutershagweg 4, 52074 Aachen) in collaboration with Aachen rail vehicle manufacturer Talbot. As reported by Professor Paul Drews and Bernd Galyga, Lassca is a modular measuring device with a laser scanner and consists essentially of a stationary applied laser light source and the mobile, easily handled receiving module. During measurement a laser beam deflected by a rotating plane mirror scans a reference area. The light plane thus created can be adjusted by micrometer screws so that the light band is positioned as closely and parallel as possible in front of the geometry to be measured, such as a rail car side panel. The laser light screen thus positioned represents a reference

for the straightness and evenness measurement. In contrast to mechanical aids it does not lose its good properties even when the measuring system is exposed to the rough production conditions in heavy machinery construction.

Adjustment can be undertaken without auxiliary equipment by the operator in a short time after naked eye measure, since the semiconductor laser utilized puts out red light in the visible range with a wavelength of 671 nanometers, it is said. Any remaining obliquenesses in the light reference plane would be automatically compensated for by the system during the measurement process, it is further said. However, the precondition for this is that the field of tolerance of 55 millimeters at present is not exceeded.

The light receiver used in addition to the laser light source contains the entire microprocessor-controlled evaluation electronics. With its small dimensions and its low weight of only about 3.5 kilograms, the light receiver can also be coupled to existing industrial robots. The housing is equipped with wheels and thus permits surface scanning of the workpiece step by step. The operator rolls the measuring receiver along the surface and thus follows the unevennesses of the object to be measured. Optical equipment attached to the front side of the receiver thereby forms the position of the light section of the laser light reference plane onto the photo-sensitive elements in the interior of the receiver. The continuous scanning and subsequent evaluation of the signals thus acquired then provide information about the true surface condition and thus about errors in the geometry. The system was expanded when the Aachen researchers succeeded, using light travel measurements, in also including the receiver module's two position coordinates placed vertically to the error coordinates of the workpiece. The concept thus represented a "three-dimensional measuring stick." The basic idea for the development of Lassca was to generate an industrially usable measuring system for computer-supported measuring of three-dimensional geometries of large, structured bodies in the form of grid models. Equipped with the new system, thanks to the implemented operator control a worker can carry out the measurement almost without preliminary knowledge and with a small amount of training expense, in the opinion of the Aachen scientists. Tests undertaken by the rail vehicle manufacturer Talbot and the European Center for Mechatronik showed a ten-fold increase in measurement speed and measurement accuracy compared to conventional methods. Meanwhile, it has been possible to achieve a measurement resolution of 0.02 millimeters, so that in the future the application area need no longer be restricted to vehicle measurement.

If large workpieces such as body parts for busses or rail vehicles are to be measured, errors frequently occur in the exact use of measuring tapes and straight edges. A laser light system with a rotating laser beam developed at the European Center for Mechatronik in Aachen will

provide help for this and permit exact measurement even of overdimensioned large vehicles. The equipment, which is easy to use, can be operated even by non-experts after a brief training period, according to information by the Aachen scientists. When rolled across the surfaces of the workpiece, shown here in the picture [not included], the system acquires all the important parameters for surface recognition and is thus able to record a precise picture of error spots in the contour of the workpiece. The rail vehicle manufacturer Talbot in Aachen uses the laser light scanner for production of large-capacity trains and railroad cars. By means of light travel measurements the developer was also able to include the two vertically located position coordinates in the light receiver modules needed for the error correction of a workpiece. With that, the measurement system was expanded into a "three-dimensional measuring stick."

Germany: Company President Sees Transrapid Operating by 2004

AU0810210794 Frankfurt/Main FRANKFURTER
ALLGEMEINE in German 8 Oct 94 p 12

[Article entitled: "Transrapid Should Be in Operation by 2004"]

[FBIS Translated Text] Thyssen Industrie AG, Essen—Eckhard Rohkamm, president of the leading company in the consortium that is to make the high-speed train operational, believes that it would be possible for the Transrapid train to operate the stretch between Hamburg and Berlin by the year 2004. However, it is essential that it should be connected to inter-city express stops in both cities, said Rohkamm, speaking in Mannheim. He is confident that work on constructing the route can begin in two to three years. If everything goes according to plan, he can imagine the first export orders ("from outside Europe") being received by the turn of the century. Currently, Transrapid is being continually tested at the Emsland trial route and the tests are to be completed by next year. That must be followed up by approval for the transportation of people. A further step in the implementation of the project is to take place on 13 October. The Magnetic Levitation Planning Company Ltd. is to be established at Schwerin, one of the Transrapid stops, in the presence of Transportation Minister Matthias Wissmann. It is to speed up planning and zoning procedures for the route.

The Federal Council on 23 September approved the magnetic levitations planning law. Currently, the costs of the entire project are to be covered by 5.8 billion German marks [DM] from the public purse and about DM4 billion for the operation of the train provided by industry and banks, said Rohkamm, addressing the Kurpfalz Economic Journalists Club. However, Deutsche Bank estimates that the total cost, including inflation and interest, will amount to DM12.2 billion. Rohkamm defended the contribution from the public pursue by citing the example of the German Federal

Railroad AG, whose railroad tracks are owned by the federal authorities. The operators of the Transrapid route would not only pay a charge for using the track, but would also bear half the depreciation costs, which is something that "railroad boss Duerr will not be able to do," said Rohkamm. He believes that the route that has been established is vital. If those who have initiated the Transrapid project are forced to make changes, the project will be immediately called off. The operators want to use existing railroad tracks for travel into Hamburg and Berlin. For that reason alone, the Federal German Railroad AG is indispensable as a partner. Duerr, however, has made it clear that he is only half-hearted in his support for the project.

BIOTECHNOLOGY

France: CNRS Teams Progress in Arabidopsis Gene Mapping

BR1310132294 Paris BIOFUTUR in French
Sep 94 p 29

[Unattributed article: "A Successful Research Group"]

[FBIS Translated Text] Since 1991, as part of a research group (GDR 1003) created by the CNRS [National Center for Scientific Research], some 10 teams affiliated to the CNRS and INRA [National Institute for Agronomic Research] have coordinated their activities in order to undertake research into the genome known as Arabidopsis. This group includes two teams from the Plant Molecular Biology Institute (IBMP) of the CNRS in Strasbourg (C. Gigot and J. Fleck), a team from the Vegetable Science Institute of the CNRS in Gif-sur-Yvette (J. Giraudat), three teams from the INRA in Toulouse (B. Lescure, D. Roby and J-L. Charpentreau), an INRA team in Versailles (M. Caboche) and joint teams from the CNRS and the universities of Perpignan (M. Delseny), Grenoble (R. Mache) and Orsay (M. Kreis). The mission of this research group is to undertake an inventory of the Arabidopsis genes by partial DNA sequencing over 300 nucleotides, and then to gene-map these markers. Several DNA banks, relating to the scientific interests of each team, have thus been created and evaluated. To date the areas covered concern flower development, embryogenesis, seed ripening and desiccation, the development of weak shoots, metabolic pathway monitoring, cell cycles and defensive reactions to pathogenic agents. A specific database has been created in Toulouse for the centralization and overall processing of the data produced by the sequencing process. The setting up of an online forum is making rapid communication between the participants easier.

As early as the end of 1992, more than a thousand markers had already been entered into the database. They now number more than three thousand. Slightly over one-third of the DNA clones analyzed relate to proteins presenting similarities with known proteins

Many correspond to genes involved in cell function, not yet identified in vegetable matter and sometimes unexpected: fibrillarin, annexins, hemoglobinase, oncogens, specific brain proteins, etc.

The priority is now to map the genes identified by partial sequencing which are of interest. It is with this in mind that, in cooperation with the CEPH [Center for Human Polymorphism Studies], a YAC [Yeast Artificial Chromosome] bank has been set up with inserts of nearly 0.5 Mb. Further inventorying of the Arabidopsis genes will, in the medium term, run up against a superfluity of clones to be sequenced. Procedures for selecting clones and managing the databases should be implemented.

In view of the many requests for clones received from laboratories all over the world, this initial phase of the GDR's program—which initially received strong support from the CNRS and the Genome Greg GIP [Public Interest Grouping]—is a success. The experiment in working in a "limitless laboratory" is a success and an example to be followed.

France: First Cystic Fibrosis Gene Therapy Test Under Way.

*BR1810155294 Paris AFP SCIENCES in French
8 Sep 94 p 27*

[Unattributed report: "Cystic Fibrosis: First French Gene Therapy Test Under Way"]

[FBIS Translated Text] Paris—The first gene therapy test has just begun in Lyon, in Professor Gabriel Bellons' department, and the first patient will receive this experimental treatment on 20 September. This was announced on 6 September by the French Association to Combat Cystic Fibrosis (AFLM).

Initially planned for August 1993, the test using this therapy, which should one day help to improve the patients' respiratory function, had been postponed for technical reasons. Now the genetically modified virus consignment, which has been prepared for the test by the Strasbourg Transgene company, has received clearance from the relevant commissions. These viruses (adenoviruses) will carry the healer gene to the patients' lungs.

Two patients have already entered the preliminary phases this August. On 20 September, the first patient, who is male and adult, will receive the treatment by aerosol, in order to introduce the healer gene into his organism. At this stage of the test, the feasibility and harmlessness of the method will be checked before ascertaining that it is effective.

The gene is thus carried directly into the lungs by the virus to produce a cell control protein, called CFTR. This cell protein is faulty in cystic fibrosis and leads to the production of secretions (mucus) which are too thick and which cause serious respiratory problems when they accumulate.

The clinical symptoms of the disease are repeated infections, serious respiratory insufficiency, digestive trouble and reduced life expectancy. It can also lead to sterility in men. It is the primary serious genetic disease in children: In France, each day one child is born with the disease. It is not contagious but hereditary and it is equally prevalent in both sexes. More than two million healthy people carry the faulty gene and can pass it on to their children.

The first gene therapy cystic fibrosis tests on humans began in April 1993 in the United States. Dr. Ronald Crystal used an adenovirus for these tests, which had been engineered by the French scientist Michael Perricaudet. Other tests have been done since then, particularly in England, using liposomes (fat microparticles) which are different gene carriers.

Germany: Nondestructive Testing of High-Performance Composites Using X-Rays

*94WS0526B Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 16 Sep 94 p 8*

[Article by oel: "Improved Testing of Composite Materials"]

[FBIS Translated Text] Frankfurt—The Berlin Federal Institute for Materials Research and Materials Testing (BAM) has developed a new test method for nondestructive testing of high-performance composites, which, according to all results available so far, permits more precise detection of wrongly included components.

High-performance composites use thermoplastic polymers together with polymer fibers or carbon fibers. But when the resins used do not enter into a close, solid compound with the polymer matrix, the solidity properties change and spots develop where breaks or cracks in the materials can start.

The new X-ray method is based on the following fact: When so-called soft X-rays are aimed at the material and the fibers embedded in it, a different refraction behavior results when faulty components are present. They can then be precisely detected on X-ray films and also be subjected to quantitative analyses. By so doing it is possible to find poorly embedded fibers, as well as other foreign bodies such as unintentionally included paper strips. Such flaws, which principally occur during manufacture of composite materials from their components, have only been insufficiently determined with the examination procedures used until now.

The new examination process will significantly facilitate the testing of high-performance composites for use in aircraft manufacture or in space technology and thereby meets the high safety requirements which must be placed on composites in these fields. Additional information: Federal Institute for Materials Research and Materials Testing, Unter den Eichen 87, D-12205 Berlin.

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COMPUTERS

France: First European Cray-Compatible Supercomputer Described

BR1310162194 Paris *ELECTRONIQUE INTERNATIONALE* HEBDO in French 8 Sep 94 p 17

[Article by Pierrick Arlot: "Europe's First Cray Compatible is On Track"]

[FBIS Translated Text] Lyon—An architecture which makes it possible, in most applications, to bring performance levels up close to a theoretical peak, while using as many standard components as possible. Software which instantly allows access to a huge catalog of existing applications. These are the two main features of the future supercomputer from Stern Computing Systems, the company headed by Jacques Stern, former "boss" of Bull and a fervent defender of European high-performance computing. It is planned to market the first SSP/Enterprise symmetrical multiprocessor systems (SSP meaning Shared Sustained Performance) in the second quarter of 1995, but Stern Computing Systems should, in the coming weeks, bring out the first industrial prototype of an operational machine.

Derived from developments brought about since 1990 by ACRI (Advanced Computer Research International), a subsidiary of Stern Computing Systems based in Lyon, the supercomputer's performance should be comparable to that of Cray Research's vector machines—the obligatory reference point in the scientific and technical supercomputer market which Stern Computing Systems has in its sights—but at a far more "reasonable" price. This result will be obtained thanks to the original architecture of the system's central units.

Separating Addressing and Control

"Some applications, mainly in the automobile and aeronautical sectors, change very fast and the computing power they need must more or less advance by a factor of five every year. In such conditions the worldwide market for supercomputers, which today is worth an estimated 24 billion French francs [Fr] and which regularly increases by six to eight percent a year, is not only reserved for machines costing Fr150 million," indicates Tor Bloch, general manager of Stern Computing Systems. "Our ambition is to market superc/yuse and capable of running applications which already exist."

For these reasons the manufacturer has not chosen a massively parallel architecture, which according to ACRI [Advanced Computer Research International] would mean completely re-writing applications software developed for vector machines. In fact, in 1993 ACRI signed an agreement with Cray Research to develop Fortran 90 compilers compatible with those of the American manufacturer. This characteristic should make it easier to port applications developed on Cray systems to ACRI's computers. The manufacturer has also opted for

the DEC Alpha processor and an improved version of the Unix DEC OSF/1 compatible operating system. This choice again guarantees binary compatibility with the servers and workstations in the American computer manufacturer's Alpha/AXP range.¹

Called SSP/Risc, the architecture of each of the SSP/Enterprise supercomputer's central units (it can contain six) is mainly based on the separation of addressing and control functions, which increases the system's functional parallelism. This principle, which was originated by ACRI, should allow the machine to offer the highest level of "sustained" power in the world (1.5 GFlops [Floating Point Operations Per Second] with a peak power of 2 GFlops). In this "disassociated" architecture, each CPU [Central Processing Unit] is in practice composed of three units: a control unit, an addressing unit, and a data processing unit, the compiler creating three distinct instruction flows.

The control unit and the addressing unit act in such a way that the processing unit is never left waiting for data from the memory and functions at 100-percent capacity. The addressing unit in fact generates the memory addresses of the data and stacks the latter in a queue, several cycles (lasting 6 ns) before it is required by the processing unit. The control unit, which executes the program, operates, so to speak, even higher up the chain and instructs the other two units to execute the code and program loops. The advantage is that while the addressing and computing units are working on any given program loop, the control unit is already preparing the next instructions. In this way, the processing unit is never idle.

Thanks to this "disassociated" architecture, the processor's performance is independent of memory access time, which makes it possible to use ordinary, inexpensive DRAMs [Dynamic Random Access Memory]. The supercomputer's memory capacity can also reach from eight gigabytes now to up to 128 gigabytes with forthcoming generations of DRAMs. For the control unit, the manufacturer has used the DEC Alpha AXP processor which has a speed of 225 MHz, the addressing and processing units being Asic GaAs units supplied by Vitesse.

Stern Computing Systems, which has also benefited from support from the European Community through various ESPRIT [European Strategic Program for Research and Development in Information Technology] projects, is reckoning on selling around ten supercomputers a year in the first few years but quickly rising to several hundred units. "We must have a turnover of Fr1 billion as soon as possible in order to fund our research and development," notes Tor Bloch.

[Caption] With a height of 1.9 meters and a diameter of 1.4 meters, the SSP/Enterprise system is octagonal in shape, with an architecture based on a passive three-dimensional crossbar back panel 64 bits wide with a speed of 30 Gb/s (around 16,000 connections). The

components of the crossbar, developed in BiCMOS [Bipolar Complementary Metal Oxide Semiconductor] by Texas Instruments, are shared between CPU cards (level 1) and memory cards (level 2). The system is air-cooled.

Footnote

1. The majority shareholders of Stern Computing Systems are Jacques Stern, the founders and employees. None of the outside investors, which include Digital, France Telecom, EDF [France Electric Power Company] and CEA Industries, holds more than eight percent of the company's capital. Stern Computing Systems holds 100 percent of ACRI, which is responsible for the development and production of the machines, and has a majority shareholding in ACSET (Advanced Compiler and Software Engineering Technologies), the company undertaking the software development (compilers). Cray Research holds 25 percent of ACSET's capital. The company has brought together an international team of 150 engineers.

DEFENSE R&D

France: Latest Apache Missile Test Results

BR1710130494 Paris AIR & COSMOS AVIATION INTERNATIONAL in French 9 Sep p 94

[Report by Pierre Langereux: "The Apache Hits a Target at 140 Kilometers Distance with KRISS—Successful Maiden Flight of Matra's Powered and Guided Antistrip Cruise Missile"]

[FBIS Translated Text] Noel Forgeard, Chairman and Chief Executive of Matra Defense Espace, revealed at the Farnborough Airshow last week that the first full flight of the Apache cruise missile had been successfully completed. This included the final phase with the firing of two KRISS-powered and self-guided anti-strip [antipistes] sub-weapons on a target at the end of the 140-kilometer flight. This information was confirmed in greater detail on 6 September by the DGA (General Arms Delegation).

The test was carried out by the Landes Testing Center (CEL) at Biscarosse from a twin-seater Mirage 2000-N from the Cazaux Flight Testing Center (CEV). The innovative and complex testing mechanism included for the first time a pathfinding system in real time with the aid of Navstar/GPS [Global Positioning System] navigation satellite receivers. According to Noel Forgeard, "the Apache was dropped by the aircraft at 800 meters altitude" and "it flew for eight minutes covering 140 kilometers," or an average speed of about 1,000 kilometers per hour.

Matra also disclosed the film of the test showing the main phases of the Apache flight (with altimetric adjustments), piloted in inertial navigation by a GPS receiver. The DGA indicated that it had "followed a trajectory of

140 km representative of an operational flight and aiming to display the maneuverability of the missile" which flies at very low altitude powered by a turbojet equipped with navigation adjustment and target-finding instruments (the Promethee self-guiding devyZyHqZ is very discreet)!"

The DGA stressed that "this first fire of the powered Apache marks an important stage in its development, which concludes in 1997 with the first deliveries to the Air Force in 1998," to equip the Rafale and Mirage 2000-Ds. The Apache is also being adapted to equip the Luftwaffe's Tornados, and Noel Forgeard said a simplified version (with GPS guiding) is being studied for the RAF's CASOM [Conventionally Armed Stand-Off Missile].

ENERGY, ENVIRONMENT

Germany: Pilot Plant Decontaminates Uranium, Radium From Polluted Waters

94WS0528A Munich DER FRAUNHOFER in German v 2, 1994 pp 32-33

[Article by Monika Weiner: "Special Molecules Decontaminate Polluted Water"]

[FBIS Translated Text] They filter out poisons, drain sludge, capture heavy metals, cleanse raw materials, protect against rust and even make hair manageable. Water-soluble polymers can be used almost anywhere. Researchers at the Fraunhofer Institute for Applied Polymer Research (IAP) are working on the design of new molecular structures. They are developing new polymers which can do even more: they help clean up waste sites, treat drinking water, clean waste water in water purification plants and refine products.

The backdrop is the Erz Mountains. Once people dug for silver here. After the Second World War uranium mining began on a large scale. Along with the ore, mountains of "dead" stone saw the light of day and ended up on the slagheaps. After reunification mining was halted. But the results remained: rainwater becomes contaminated with uranium, radium and arsenic through contact with the radioactive stone, flows out from under the slagheaps and reaches streams, lakes and the ground-water. An environmental problem that grows with every rainstorm. High time to do something. "Traditional purification procedures reach their limits here," explains Dr. Werner Jaeger of the Fraunhofer Institute for Applied Polymer Research (IAP) in Teltow. The reason: the heavy metal salts are toxic, cannot be filtered out, and are resistant to absorption by microorganisms and other biological decomposition processes. Classical separation procedures, such as hydroxide or sulfide precipitation, are too complicated or too inefficient.

The new defense against radioactively contaminated water seepage developed in the "water-soluble polymers" working group at the IAP has no side effects. It

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answers to the exotic name PAN-HYA, is effective, economical, odor-free and reusable. It belongs to the family of synthetic water-soluble polymers. Non-water-soluble polymers, on the other hand, are suitable for the manufacture of flower vases, gutters and plastic packaging.

This PAN-HYA is for dump site cleansers what worms are for the fisherman: bait. Polymer molecules become bait by being given a clearly defined chemical structure in which characteristic ion groups are arranged at certain locations. Such giant molecules, which have different charges at their ends and thus can react multiply, as a base or as an acid, are called polyampholytes. When uranium compounds "take" the bait, PAN-HYA changes into thick, highly sedimentable flakes which can easily be separated.

This procedure is already being used in a pilot plant in Poehla, on the grounds of the company Wismut AG. The plant was developed by Fraunhofer researchers together with the Hildebrand Ingeniurbuero GmbH. Here 50 liters of percolated water an hour are decontaminated: first the right pH value must be created by the addition of acids; then barium salts are added. The result is a barium sulfate precipitate which is precipitated together with the radium. In the second step, PAN-HYA is added, and the uranium attaches itself to it. In the process flakes are formed which can be filtered out. The uranium compounds are concentrated in the resultant filter cake. The remaining percolate is now free of uranium and radium. It does still contain arsenic, which is eliminated by the addition of iron: ferrous arsenate is precipitated and filtered off. What is left now is pure water without radioactive or toxic residues. "The pilot plant has shown that PAN-HYA is an effective means of water purification," says the project director, Dr. Ulrich Gohlke. As early as next year a large plant operating on the same principle should be opened. It will be able to clean 500 cubic meters of water an hour.

Heavy metals are not the only materials which Jaeger and his colleagues catch with polymers. Differently constructed polyampholytes allow dyes, oils and tensides to be separated out. These materials combine with positively or negatively charged "anchor groups" on the polymer molecules. Polyampholytes are therefore used for waste water purification in the dye industry, in purification plants and in the metal-processing industry. A special receptor must often be developed in order to filter out all poisonous substances—a combination of different polymers. Even water-repelling—hydrophobic—chemicals can be precipitated with water-soluble polymers. The trick is to build hydrophobic groupings into the polymers, where the water-resistant chemicals, such as insecticides, then tie up.

Finely divided, suspended particles or suspensions can also be lured with polymers. What is needed is positively charged molecular components—so-called cationic polyelectrolytes. "The suspensions have a negatively charged

surface which surrounds them like a brush; they repel each other and therefore do not form clumps," explains Jaeger, director of the "water-soluble polymers" working group. If you add cationic polyelectrolytes, the negatively charged particles attach themselves to the positively charged macromolecules, and as a result flakes are formed. The size of these flakes depends on the length of the polymer molecules; the longer they are, the better such a flocculating agent functions. Recently the Teltow Fraunhofer team succeeded in developing branched cationic polyelectrolytes. These make it possible to improve the degree of separation even more. For example, the waste water from charcoal briquette plants can be cleaned with branched polyelectrolytes. The usable coal is separated out, and what is left is usable, cleansed water which can be used again.

Poisons seldom occur in isolation. In order to clean water completely different polymers with different baits must often be employed. The secret of polymer researchers is developing the right molecular structure for every problem. And that is why there is no patent formula to apply to environmental toxins. "Every kind of water is different," acknowledged Jaeger, who is confronted every day with the waste water problems of large and small industrial businesses and of communities. "It's true that we can turn to a basic technology to come to grips with the problems, but then we have to develop a special formula each time."

The Fraunhofer researchers have formulae for problems of quite a different kind. Flocculation agents can also be used to shorten the sedimentation periods in obtaining ores and to purify salt solutions in obtaining potash salt, to separate oil emulsions in petroleum processing and to accelerate drainage in paper production. A whole list of additional applications can be imagined. One of them is a surface covering which seals components and sheet metal temporarily.

Such a process was recently developed at the Fraunhofer Institute in Teltow, a process which protects sheet metal which has to be stored before further processing from corrosion. Previously, such sheet metal was greased. That had the disadvantage that after the sheet metal was cleaned the grease got into the waste water and had to be laboriously separated out again with a grease extractor. This expense is avoided if partially water-soluble polymers are used instead of grease. Such mildly basic polymers are insoluble in the neutral pH range, and thus in rainwater. "They surround the sheet metal and components like a raincoat which not a single drop of water can penetrate," explains project director Dr. Matthias Hahn. If the sheet metal is to be reprocessed, the polymer layer is washed off with lye—the coating dissolves in the basic pH range. This solute is then captured and neutralized with acid. In the neutral pH range the polymers are again precipitated and can be filtered and reintroduced into the process.

Water-soluble polymers are already being used in various branches of industry. In the textile industry and in

bulk cleaning, articles of clothing are coated to prevent electrostatic charge—and thus the notorious static cling. Shampoo manufacturers mix ionized, water-soluble polymers into their formulas in order to avoid giving the hair an electric charge and thus an undesirable fright-wig hairdo.

Nothing can be done these days without polymers. We use them for hair, for textiles and paper, we take them in as preservatives in foods and we drink water that has been purified with polymers. The multiplicity of the applications makes water-soluble polymers the material of the future. Worldwide more than a million tons of water-soluble polymers are already being produced and processed every year. The trend is growing, especially in environmental protection.

Germany: Energy-conserving Roof Panels Incorporated Into Roof Structures

94WS0528B Munich DER FRAUNHOFER in German v 2, 1994 pp 34-36

[Article by Franz Miller: "Solar Energy From A Thousand Roofs"]

[FBIS Translated Text] *You still need a lot of idealism to build a solar power plant on your roof in this country. But the "Thousand Roofs Program" funded by the Federal government and the Laender shows how great the interest in alternative energy sources is. The Fraunhofer Institute for Solar Energy Systems in Freiburg is in charge of analyzing and evaluating this large-scale project.*

The man from Freisinger City Services has been installing electricity meters for households for many years. But so far he has never been applauded. Today the whole family gathered in the corridor while he connected the photovoltaic equipment to the grid. Everyone wanted to share the experience of their family's own solar power plant feeding current into the public grid for the first time. Only three days ago workers had installed the solar panels on the roof; now the children announced proudly to their curious neighbors: "We are now producing our own electricity."

There are already more than a thousand families in Germany who can make that claim. A total of 2,250 photovoltaic units will be found on the roofs of one and two-family houses in the "Thousand Roofs Program"; about 1,600 are already operational. The Federal government and the Laender are supporting the homeowners with subsidies of up to 70 percent. This broad test of photovoltaic units, the biggest in the world, proves that even in the low-sunshine areas of Central Europe the utilization of solar radiation is technically feasible.

In Germany the proportion of total energy use supplied by the renewable energy sources of sun, biomass, wind and water power is still only 2 to 2.5 percent. The major portion of this, 1.7 to 2 percent, comes from water power. About 0.5 percent is produced by biomass or

waste, and less than 0.1 percent by wind energy and solar energy. Enormous rates of increase will be required in order to reach a share of 5 to 10 percent by the year 2010. Without massive and long-term subsidization these goals are not realizable.

The main emphasis of the subsidy plan, besides wind energy and thermal utilization of solar energy, is photovoltaics, the direct transformation of solar radiation into electricity. After a series of large-scale photovoltaic plants were built in the 80's, the next order of business was the practical testing of the new technology for widespread use in private homes. That is why the Federal government and the Laender began the "Thousand Roofs Photovoltaic Program" together in September of 1990. After reunification it was extended to the new Federal Laender in July of 1991. Interest was overwhelming. The Research Department had to mail out detailed information about photovoltaic units to 60,000 interested individuals. "This means that the Germans are probably the best-informed population in the world on the subject of photovoltaics," says Dr. Walter Sandtner, the expert on this topic at the Federal Research Department. In the end 3,800 requests for funding for roof-mounted photovoltaic installations were mailed in. Following a formula negotiated with the Laender—150 for the regional Laender and 100 for the city-states—a total of 2,250 installations are being approved. Funding was limited to private households and installation sizes of one to five kilowatts. This means that by the end of this year nearly six megawatts of solar energy will be available on German roofs—more than in any other country in the world.

Initial experiences and results of the "Thousand Roof Program" were presented at the "photovoltaic solar energy" symposium in Kloster Banz in Staffelstein, where solar experts from research, politics and administration meet annually with experienced people from trade and industry. BMFT [Federal Ministry for Research and Technology] review director Dr. Sandtner emphasized that this widespread test has provided important stimuli for practical applications of photovoltaics. He said that the plan was already justified by the fact that other countries have begun imitative programs. The Japanese were particularly thorough in adopting the German program as a model; they obtained detailed information about its planning and execution and invited the German photovoltaics experts to give lectures in Japan. Now they are even planning a 70,000-roof program.

There was lively discussion in Staffelstein about the demand for compensation for solar energy to cover costs. Some city councils want to pay the operators of solar installations about 2 German marks [DM] for current which is fed in, following the so-called Aachen model; the usual amount is less than 20 pfennigs. But if the cost were distributed among all consumers—they must subsidize solar energy—the cost of electricity would only

rise by 0.08 pfennigs per kilowatt hour. Since the energy-providing companies (EVU's) earlier banned contributions to the grid from small current producers, many solar pioneers are simply happy that this hurdle has finally been removed by the thousand-roof program, and that now all EVU's are obliged to accept the electricity and to pay at least 90 percent of the average price for electricity.

Many old battles between solar pioneers on the one side and energy-providing companies, manufacturers and officials on the other have been resolved in the three years of intensive cooperation.

A measurement and evaluation program which is to extend over many years has been linked with the experiment to permit comprehensive conclusions to be drawn from these experiences. It is to be coordinated by the Fraunhofer Institute for Solar Energy Systems (ISE) in Freiburg. For five years the solar energy produced, the electricity usage of the household and breakdowns and repairs will be recorded for each of the 2,250 installations. Volker U. Hoffmann of the ISE working group in Leipzig reported that the band width of the size of installations ranges from 1 to 5.4 kWp. There are peaks at 1.5, 1.6, 2.0 and 3.2 kWp. The reason is the inverters, which are often set for a certain modulation number.

The cost of installation is also characterized by a very wide range: it ranges from DM17,000 to DM37,000 per kWp and varies between the individual Federal Laender. On average, the installations were most expensive in Hamburg. Since the program began there, it is likely that the installing companies were able to lower their prices after they had some practical experience. But Volker U. Hoffmann has not yet been able to account for the extreme variations in cost. It surprised researchers that an extraordinary number of installations cost exactly DM27,000 per kWp, but it didn't surprise the installation companies—after all, that was pricesly the upper limit of funding. And tradesmen know something about a market economy.

The units from the Siemens company still dominate, although their relative share fell from 75 percent in 1991 to about 50 percent this year. DASA [German Aerospace Company] models made up ground, while BP-Solar and other manufacturers entered the market. A similar trend from one dominating manufacturer to several was also noticeable for inverters. Obviously the development of new inverters was stimulated by the thousand-roof program. In contrast to the robust solar units, they were always considered as the weak point in photovoltaic installations. By now complaints about frequent breakdowns of the inverters have noticeably decreased. In some cases, the evaluating scientists were able to give advice about breakdowns or about a defect of installation components thanks to their measurement data.

The very first series of measurements has raised plenty of questions, but has also led to some revealing explanations. The basis for continuing investigations is the

"intensive measurement and evaluation program," in which 100 photovoltaic installations have been selected on a statistical basis. Weather and output data are recorded with special metrological electronics and automatically transmitted to the ISE in Freiburg every night via telephone modem for evaluation. This made it possible to explain why there were such extremely large differences in output between the installations. Taking the average of the 625 installations which were already operational in 1993, the installation's output was 690 kilowatt hours per kWp. A clear drop from south to north was noticeable. Because horizontal solar radiation is also recorded by the intensive measurement program, it was possible to discover that the main cause of the local differences is due to the difference in intensity of solar radiation. The difference between the best location in Rhineland-Westphalia and the worst in Hamburg was 30 percent. Obviously, it was cloudy particularly often there last year.

The main factor in poor operational results is the fact that losses due to shade were not sufficiently taken into account, as Klaus Kiefer emphasized: "Often installations were built on roofs which are not optimally suited for them." And the installers confirm the general problem: what initiates the process is not suitable roofs, but the wishes of homeowners, regardless of the situation of their roofs.

A further conclusion worth pondering was revealed by the evaluation: obviously, exaggerated predictions of totals had been submitted. And at least one manufacturer of units is being criticized because the solar units do not supply the promised output. When further weak points are exposed by the evaluations, which are only now really getting underway, ISE expert Klaus Kiefer believes that the large range of variation in energy efficiency can be significantly reduced.

The thousand-roof program was intended to achieve four goals. The first was to show how the utilization of roof surfaces for the production of electricity can be united with structural and architectonic considerations. This is demonstrated by numerous visually attractive views of houses. In general the solar units were installed on the roof; the visually more elegant integration of the unit into the roof was less frequently chosen. The remarkable restraint of architects remains mysterious. They are the very ones who could do a great deal for the visual integration of solar energy into house construction.

Whether the second goal—stimulating the occupants to save electricity and to treat solar energy properly—was achieved is discussed by the ISE group in Leipzig in conjunction with the Leipzig environmental institute in a detailed sociological companion investigation.

The goal of technical optimization of all the components has been realized in important areas even during the course of the current program. A further advance is anticipated when extensive data about operation are

available. That is why all the participants are so interested in the results of the measurement program.

Finally, the most important goal was to gain knowhow in installation. Photovoltaic installations are to become affordable, reliable, safe and basically standardized. After somewhat overhasty beginnings, everyone—scientists, manufacturers, installers and officials—agreed that a standard was achieved which could take its place worldwide. The knowhow has been disseminated to the point where a solid photovoltaic installation could be put in anywhere in the Federal Republic within a few days.

Having your own solar power plant is still more expensive than electricity from the wall-socket. But who always buys what's cheapest—for instance, when it's a question of cars or stereos? And more and more homeowners are proud when the solar cells cast their blue gleam from their roofs.

Germany: Early Results of Solar Rooftop Program Analyzed

94WS0509A Frankfurt/Main FRANKFURTER
ALLGEMEINE in German 30 Aug 94 p T2

[Article by Georg Kueffner: "With Some Discipline Half of All Power Consumption Can Be Produced By the Sun. First Results From the 1000-Rooftop Photovoltaic Program. Very Different Yields. The Equipment Will Be More Reliable"]

[FBIS Translated Text] Whoever puts a photovoltaic power module on his roof has to have an awful lot of idealism: that is nothing new, but it has been reinforced by the first evaluation data from the so-called 1000-rooftop photovoltaic program, which have now become available. Within the framework of this pilot program initiated in the autumn of 1990 a total of 2250 rooftop solar modules were subsidized by public funds. A prerequisite was that the modules be connected to the network so that the surplus-produced current could be sent into the public network.

Between 17,000 and 37,000 German marks [DM] must be put up for each kilowatt of solar power produced by solar energy—a considerable range which cannot be attributed solely to the different prices for the necessary individual parts of a module. There is much which indicates that the various installed modules operate with very unlike profit margins. An index of this is the most frequently cited price per kilowatt hour of DM27,000. Since this amount corresponds precisely to the upper limit for which promotion money is provided. The federal government in the old federal states has assumed 50 percent of the costs and in the new federal states 60 percent. This unequal treatment has been equalized by supplementary payments from the states, so that finally each module has been subsidized up to the level of 70 percent.

The output of the modules also is very different. It ranges from 1 to 5.4 KW; the "typical" photovoltaic module can be expected to supply an output of about 2 KW. The solar experts of the Fraunhofer Institute for the solar power system in Freiburg, under whose oversight an extensive measuring and evaluation program is to be carried out during the next five years, were surprised by the greatly differing yields of the modules. On the average the annual yield of the 625 studied modules was 690 kwh for each installed kilowatt. The south-north gradient, moreover, was especially striking. For example, the difference between the best location in Rheinland-Pfalz and the worst in Hamburg was 30 percent. The difference can be attributed to the clearly worse weather conditions in the north, where during this past year on many foggy days the sun's rays could not penetrate to the solar modules. Nevertheless, it is not only on the weather which the power production is dependent; poor results are attributable, according to the findings of the Freiburg solar experts, primarily to losses caused by shadow-casting trees. In addition, the modules have often been built on houses whose roofs are not optimally suited, and, what makes it particularly more difficult, are not precisely oriented to the south. Among the friends of solar power, discontent arises due to the exaggerated predictions of output. Also, it is said that one of the installed types of modules did not have the anticipated durability. On the other hand, it appears that the poor quality of the dc-ac current inverter, which drew complaints at the beginning of the German photovoltaic era, has recently clearly become better. There have been fewer and fewer complaints of failure of this important connecting link.

To what extent a solar energy producer can cover his power requirements by his own production is highly dependent not only on the efficiency, but also on the consumption, at the moment. The best results are attained, as the evaluation indicated, by retired engineers and teachers who are scrupulous in operating current-greedy equipment only commensurate with current production. An effort is made to cover at least 50 percent of the power consumption by solar-generated current. This percentage has proven itself to be sensible; higher percentages are indeed possible, but clearly drive the investment costs upward.

Late in 1994, if all the modules of the 1000-rooftop program have been installed, on German roofs there will be an installed capacity of about 6 MW of solar-generated current, more than in any other country in the world. At present it is still difficult to foresee what the future of photovoltaic power production will be. Only with a great number of modules will the price for a kilowatt-hour of solar-generated energy be able to drop from the momentary DM2. Land-scale plans exist particularly in Japan and America. Thus, in Japan alone a photovoltaic generation capacity of 4.6 gigawatts will be installed by the year 2010. Clearly more modest steps will surely be taken in Germany. Nevertheless, nothing will change with respect to the largest rooftop-installed

solar power plant in the world which will be built within the grounds of the international Emscher-Park Construction Exhibition in Gelsenkirchen. In the first construction stage cells with a total power production of 200 KW will be installed. Clearly the power output would be greater if the facade of the elongated building could be studded with solar modules—a possibility which would make sense only if the buildings had been turned 90 degrees and had been oriented to the south.

Germany: R&D on Superconducting Magnetic Energy Storage Funded

MI1310104594 Bonn TECHNOLOGIE-NACHRICHTEN
MANAGEMENT-INFORMATIONEN in German
30 Aug 94 pp 17-18

[FBIS Translated Text] Even today, there is still no satisfactory technical solution to the storage of electrical energy. The Federal Ministry for Research and Technology [BMFT] is therefore also supporting research in the field of superconducting magnetic energy storage [SMES].

SMES is capable of storing very large quantities of electricity with low losses, and releasing the stored energy on demand at short notice. In particular, the use of SMES in power stations for meeting a sudden surge in demand within seconds will be explored as part of a feasibility study funded by the BMFT. The energy supply companies Preussen-Elektra AG, RWE Energie AG, and Siemens AG are taking part in the project.

Superconducting magnetic energy storage is regarded as a promising technology of the future. International research all over the world, particularly in Japan and the U.S., is aiming to develop the technology to such an extent that superconducting magnetic energy storage with a moderate energy content can be in practical use by the end of the century. A preliminary study has shown that SMES with an output of about 100 Megawatt and an energy content of approximately 2 Megawatt per hour could be a useful size.

The research currently in progress will concentrate on the design and layout of SMES and how to incorporate it in the control of the electricity supply networks. It will show how SMES can be used as a so-called split-second reserve in the European integrated network.

The purpose of the split-second reserve is to create a balance between production and consumption and, in particular, to support the network in the event of power station failures. To this end, the energy supply companies must always keep 2.5 percent of their generating capacity at any one time as a reserve available at short notice. As this reserve is lost if it is not used, it is useful to store it without loss in a suitable medium, for example, superconducting magnetic energy storage. Energy can be saved with a split-second reserve from SMES.

Another objective of this research is to optimize the use of SMES in conjunction with other possible ways of providing the split-second reserve.

In the case of superconducting magnetic storage, the electrical energy is stored in the magnetic field of the coil assembly. The high magnetic fields required for this can be produced only by superconducting coils at very low temperatures (-270°C) in which the electric current flows without loss.

The use of superconducting magnetic energy storage means advancing into new technological territory, and entails considerable risks for the companies involved. The BMFT is funding this research because widespread use of SMES would permit substantial savings on natural resources and would thus lead to a reduction in CO₂ emissions.

The BMFT is providing 1.68 million German marks [DM] for the project until February 1996.

Further information can be obtained from the Biology, Energy, Ecology sponsor of the Juelich Research Center, Dr. Rolf Windheim, 52425 Juelich, tel. 02461/614233, fax 02461/612844.

Germany, Spain Build Major Photovoltaic Power Plant

MI2909144594 Bonn BMFT JOURNAL in German
Aug 94 p 11

[FBIS Translated Text] One of the largest photovoltaic plants in the world has now been officially opened near the Spanish city of Toledo. The BMFT [Federal Ministry of Research and Technology] contributed 2 million German marks [DM] to the European project. The funding was conditional upon new types of solar cells being used, about 50 percent of which were produced in Germany. Moreover, it was agreed that German scientists should have the opportunity to carry out scientific and technical tests on part of the photovoltaic plant. Close cooperation between German and Spanish companies is offering the chance to gain extensive experience with the construction and operation of a photovoltaic power station and its components.

The plant was fitted both with German solar cells made by Nukem (450 kw) and Spanish-made solar cells from BP Solar (450 kw and 100 kw). The efficiency of the 2,112 metal-insulator-silicon inversion layer solar cells made by Nukem each with an output of 216 watt per module is 11 percent. The 4,704 modules of BP Solar have an output of 90 watts each and are composed of Laser-Grooved Buried Grid solar cells, in which the contact grid is "buried" on the cell surface by means of lasers. Their efficiency is 15 percent. The photovoltaic plant will generate about 1,700 megawatt/hour of energy per year.

About 18 km away, a hydroelectric power station is in operation with an output of 76 megawatt and an annual

energy yield of about 180 gigawatt/hour. One of the main objectives of this project is to operate the photovoltaic plant in combination with the hydroelectric power station. Moreover, both types of cell will be tested, and a comparison made between fixed and compensating systems.

Germany: Fossil Fuel Alternatives Studied

Photovoltaic Project in Spain

95WS0001A Berlin INGENIEUR DIGEST in German
Sep 94 pp 55-56

[Article by Hartmut Kowsky-Kawelke: "Breakthrough in Toledo?"]

[FBIS Translated Text] *The first large-scale photovoltaic plant in Europe was built in Spain—constructed by RWE Energie AG. Will the power giants launch an eco-program?*

Even sober experts get bowled over once in a while. They are praising the first example of large-scale technical application of photovoltaics in Europe as a "breakthrough for solar energy." The power plant has a peak output of 1 MW and will deliver up to 1.7 million kWh power annually.

At the beginning of June the energy supplier from Essen, together with the Spanish energy company Endesa, began operating in the vicinity of Toledo a photovoltaic facility, which combines two ecological energy sources: the engineers coupled the solar power plant, which converts sunlight directly into power, with a hydroelectric facility on the river Tagus which flows past it.

The trick of the coupling technology solves the important problem of availability of renewable energy sources optimally: when the Tagus is at a low water level in the summer, the solar power plant achieves its highest capacity. When the water level in the river is high in the winter, the solar radiation, and thus the solar power output, is lower.

That is how the maximum output of 1 MW is to be evenly available. It is enough to supply a town of about 2,000 inhabitants. In comparison: nuclear power plants and modern hard coal power plants have peak outputs of 2,000 to 3,000 MW. In comparison, the world's installed photovoltaic plants, now with a total of 60 MW capacity, still look quite modest.

That is no different in Germany. In 1990 the share of renewable energies of the primary energy use amounted to 1.5 percent. By 1992, according to information from the Association of German Power Plants (VDEW), it had grown only marginally, to 1.7 percent.

The three European energy suppliers are investing about 24 million German marks [DM] in Toledo. The EU [European Union] supported the ultramodern solar power plant within the framework of its Joule and

Thermal programs. In addition, money was supplied by the BMFT [Federal Ministry for Research and Technology] and from Spanish government funds. But even with its innovative technology, and despite its size, unusual for a photovoltaic power plant in Europe, the plant is not economical. According to its own calculations, the RWE assumes that the solar power is about four times as expensive as power from a conventional power plant. The efficiency of the 7,940 solar collectors in Toledo is approximately 17 percent.

RWE is not the only power giant taking an eco trip. Bayernwerke, for example, is backing a project in Neuburg vorm Wald using solar energy for hydrogen production. Together with Siemens AG and additional partners, they have now invested about DM65 million in these experiments. The joint venture with Siemens-Solar is now testing the establishment of new production capacity for photovoltaic modules. An investment of approximately DM200 million at Wackersdorf in the Upper Palatinate is being discussed.

Market prognoses confirm the trend: annual growth rates of 20-30 percent. But the focus of solar energy utilization will perhaps remain in the field of indirect conversion. With solar thermal power solar collectors utilize the thermal energy of the sun's radiation for heating purposes or to heat water. Here the green technology is already paying off. Experts calculate that investments in solar thermal modules need not quite 10 years in order to amortize themselves. Indoor swimming pools, office complexes, administrative buildings or business firms increasingly often put up glass tubes on the roof in order to generate hot water or to supplement the heating.

At the moment, wind energy utilization is also enjoying a quiet boom. In 1993 alone the installed capacity for wind power facilities grew from 175 MW to 330 MW. The power production of all rotors in 1993 amounted to about 570 million kWh. In other terms, that is an amount sufficient to supply 200,000 households. On 8 July another wind farm, which is also Germany's largest, began operating on the Baltic island of Fehmarn. The 34 generators in two locations have a capacity of 17 MW. They are to deliver 45 million kWh power a year.

The capacity of each wind power plant is growing increasingly larger. In the last few years it has grown tenfold to 500 kW. With this range of output wind energy will also be more heavily utilized in the interior of the country. Even in 1993 about 20 percent of the generators were far from the coast.

Utilization of water power plays an increasingly important role in the new laender as well. The development of water wheels with improved efficiency was the reason why as early as the 1980s many small hydroelectric plants were built in the old laender. The energy supply companies in Swabia thus lined the rivers of the land with a whole series of such plants. In the new laender experts have already reported on approximately 700 suitable locations.

Despite the multitude of support programs, the critics are not satisfied by far. Their demand: Photovoltaics, thermal solar energy use, wind and hydroelectric power as well as geothermal power, must finally be supported to the same extent as nuclear power and efficiency increases for energy production from fossil fuels, for example.

Developments in Geothermal Heating

95WS0001B Berlin *INGENIEUR DIGEST* in German
Sep 94 p 56

[Article by Hartmut Kowsky-Kawelke: "Heat From the Deep"]

[FBIS Translated Text] "With this thermal power plant we will be able further to develop our know-how in geothermal application and acquire other operational experience," says Dr. Heiner Menzel happily. Together with other engineers and technicians in Mecklenburg-West Pomerania, the project leader developed geothermal high-tech even during the GDR period. In 1989 geothermal facilities were in operation in Neubrandenburg, Waren/Mueritz and Prenzlau. With their installed capacity of 22 MW they were four times larger than all the drillings utilizing geothermal energy in West Germany. By 1989 they replaced about 26,000 tons of brown coal.

The new construction of a plant at Neustadt-Glewe, which will pump 100°C water from a depth of 2,250 m, is linked to this. It will cost approximately DM18 million. Fifty percent of that will come from subsidies from the Federal Ministry for Research and Technology (BMFT). It will be built by Erdwaerme GmbH, in which Westmecklenburgische Energieversorgungs AG and the small city of Neustadt-Glewe are partners. The 6.5 MW of geothermal energy predicted will supplement a thermal power plant, which in addition to the homes will also supply a leather factory with operating heat. Worldwide, about 250 geothermal power plants produce power, heat homes and factories or deliver heat for medical applications. Iceland, the United States and New Zealand are well known for their plants.

The same principle applies to all forms of utilization. With water as the medium, the heat that is present in the ground is made usable above the earth. The existing heat is a residue of the so-called original heat of the earth, as well as constantly regenerated heat from the continuing decay of radioactive material in the interior of the earth.

It becomes more difficult when there is no water present under the ground. But geothermal exploiters want to tap such regions as well. They are taking aim at the hot, essentially dry, rock formations which are located in many places in the FRG at a depth of about 5,000 meters. To Professor Fritz Rummel such hot-dry-rock systems (HDR) are "the greatest geothermal energy deposit in the world."

HDR technology has now been farthest developed in research projects by the European Union in Elsa and in Bad Urach in Swabia. It functions according to the heat exchange principle: Two holes are drilled a few kilometers apart. Water is pumped into one bore hole; it reaches the second hole through the cracked, hot rock and in so doing heats up and is then brought up to the surface.

At Urach a few years ago rock temperatures of 180°C were measured at a depth of 4,500 m. At the same time geotechnicians were able, by means of so-called frac tests, to break up cracks hydraulically and place a heat exchanger at a depth of 3,300 m. According to the intentions of geothermal proponents, such a pilot power plant is to convince even the last skeptics over the next few years. If the new production funding from the EU's Joule program is made available in 1995, it will also advance geothermal energy.

Hydraulic Power Dominates; Public Electric Supply Facilities (as of end of 1992)

	Number of facilities	Output in megawatts	Net power generation in million kw/hr
Water	660.0	4,049	15,154
Garbage	40.0	550	2,060
Biomass	66.0	39.6	139.4
Wind	192.0	36.3	66.7
Photovoltaics (network-linked)	111.0	2	0.9
Total	1,069.0	4,677	17,421

ADVANCED MANUFACTURING

Germany: Fuzzy Logic System Integrated With Conventional Control

95WS0006B Frankfurt/Main *FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT*
in German 29 Sep 94 p 8

[FBIS Translated Text] Besides the numerous applications of fuzzy logic systems already employed in various technological fields, new systems are now being developed for use in non-technical fields. The systems that have been available to date have been designed as general purpose tools which offer rule-based fuzzy systems mostly for technology fields. The user himself would have to undertake any integration with other fields as, for example, conventional automatic control engineering. Now, a scientist at Clausthal-Zellerfeld's Institute of Information Science (Professor Dr. Dietmar Moeller, Erzstr. 1, 38678 Clausthal-Zellerfeld) wants to develop tools that would be tailor-made to meet the specific requirements of individual fields such as, for example, the chemical process engineering field. To be sure, the main focal points of such research are the fields of process engineering, medical expert systems, and data

banks. New methods of development are to be researched and fuzzy technologies are to be joined with other techniques like neural networks. Experience already gained through conventional applications can be utilized to improve developmental methods or, as the case may be, replace them with new methods. Photograph (see original) shows an application of fuzzy logic technology to a riser tube with photoelectric barrier evaluation.

LASERS, SENSORS, OPTICS

Germany: Laser Machining Developed for New Materials

94WS0528C Munich DER FRAUNHOFER in German v 2, 1994 p 31

[Article by Monika Weiner]

[FBIS Translated Text] *The manufacture of components is a race against time: production cycles are growing shorter and shorter, the demand for quality is greater, the product lines smaller. New materials like specialized steels, ceramics or composites also demand high flexibility in manufacturing technology. No wonder the competitive battle is becoming tougher, particularly in small and midsized supply companies. A method developed at the Fraunhofer Institute for Laser Technology (ILT) in Aachen is making it possible to win the race against time: the laser ablation process brings even the hardest articles into shape—without changing tools.*

A push of the button is all it takes: the machine shapes ceramics, steel or plastics into the desired form completely automatically—precise to the hundredth of a millimeter. The person tending the machine only needs to play over the construction data from a CAD [Computer Aided Design] program; a laser beam takes care of the rest, guided and metered out by an ingenious automatic control technology.

In the interior of the laser milling machine, which is a good 10 cubic meters large, the article is first shaped into roughly the correct form: the laser beam, which is only a few tenths of a millimeter thick, etches the surface and melts it. A stream of gas which is produced through a jet specially developed for this process blows the melted material away. 500-1,000 cubic millimeters of a material per minute can be removed by this "laser beam smelting ablation." When the rough form is finished, precision modeling begins: again the laser beam etches the article, but this time pure oxygen is applied. The surface is oxidized in this way; fine shavings are formed. This "oxide machining" makes it possible to dig out very delicate structures precise to the hundredth of a millimeter without changing tools—and without contact or abrasion, without stressing the article mechanically.

The idea of developing such a box of wonders for the production of components and tools originates with a

company which was honored with the Innovation Prize of the German Economy for the development of a prototype.

This first laser milling machine had a few defects, however: "The procedure could not be fully controlled at that time," according to Dr. Eckhard Beyer, provisional director of the Fraunhofer Institute for Laser Technology. "Thus it lacked the required precision." The specialists at the ILT developed an ingenious control and regulation technology in the following years, which insures that the laser beam is guaranteed to hit the article at the right place with the right intensity. Here the laser is controlled by a feedback process: an optical sensor measures the depth of the ablation on-line and gives the data to a regulator. This compares the values to the desired data from the CAD program. "As soon as the preset ablation depth is reached, the regulator reduces the laser's power," explains Dirk Petring, who is in charge of the ablation procedures division at the ILT.

The combination of laser technology and sensor technology has several advantages: mistakes in processing are avoided from the beginning; there are no rejects—there is no need for additional quality control. Thanks to this automatic control technology, it has been possible to develop the laser milling machine further into a marketable product. It can be used not only to produce components like pressure die-casting forms, but also to introduce structures and textures into surfaces or to cut articles with the laser beam. The device can produce prototypes or production-line components as desired. As mentioned above, all this happens at the press of a button: as soon as the CAD data are entered, things can get going—there is no longer a need for long resetting periods.

"The laser milling machine is therefore more flexible than traditional milling and erosion processes," says Petring. For that reason alone, in his opinion, it is worth investing in the new technology: "Flexibility is decisive nowadays in machining. Only those who can avoid idle machines and lengthy resetting and can react quickly to customers' wishes will survive in international competition."

NUCLEAR R&D

Germany: Fraunhofer NMR Microscopy Development Aids Nondestructive Testing

94WS0521A Munich DER FRAUNHOFER in German v 2, 1994 p 20-21

[Article by Hellmuth Nordwig: "The Music of the Atomic Nuclei"]

[FBIS Translated Text] *Doctors and materials researchers have the task of observing dynamic processes in material in a tiny space. They are helped by a development in which Fraunhofer researchers played a significant role: they can analyse changes in chemical*

composition, whether in a tool or in biological tissue, nondestructively and in real time with the help of nuclear magnetic resonance microscopy.

It has been on the wish list of materials scientists for a long time: a microscope which not only provides cut-out-sharp pictures, but at the same time nondestructively and noninvasively provides information about the areas of the object in which certain chemical compounds are located. Or what about a microscope with which you can see directly how two glass-clear liquids mix? Anyone who thinks that such a thing would be impossible will learn better from the Fraunhofer Institute for Biomedical Technology (IBMT) in St. Ingbert—from Dr. Winfried Kuhn, who was a decisive participant in the development of NMR microscopy.

The English abbreviation NMR stands for nuclear magnetic resonance. What goes on in an NMR experiment is no different from what happens with a top which a child pushes out of its upright orientation. But what circles here is smaller by several orders of magnitude: atomic nuclei with their characteristic spin. The direction of an external magnetic field is their axis, along which they orient themselves. If this regular spin is disturbed, the atomic nucleus wobbles just like the toy. This experiment determines the resonance frequency with which the nucleus oscillates arounds its own spin axis—and that depends on the chemical element which it represents. For groups of molecules are like an orchestra: piccolo flutes simply have a different range than horns or contrabasses, hydrogen nuclei have a different resonance frequency than carbon or phosphorus.

But a good musician also adjusts himself to the person next to him at the music-stand. The resonance frequency of atomic nuclei also depends on their immediate chemical environment—the hydrogen nuclei of water wobble with a different frequency than those which are located in fat molecules. Thus which chemical compound is contained in a sample can be determined by a simple NMR experiment. For every substance provides a characteristic spectrum of resonance signals. A modern NMR spectrometer costs about 1.5 million German marks [DM]; by now it is an essential investment for every institute at which analyzing the structure of organic molecules plays a role—as much in the medical field as for instance in the analysis of foodstuffs. Botanists use this method, for example, to find out what gives fennel its taste—a precisely defined formation of different fats and aromatic oils which are also responsible for its pharmacological effect.

Up until now it was not possible to make any statement about which cells in a fennel bulb produced a certain aromatic material. But Winfried Kuhn would not leave this question alone. In cooperation with an international team of researchers, he developed a method of establishing the distribution of aromatic substances in fennel with microscopic resolution. The trick of NMR imaging

is overlaying a static, homogeneous magnetic field with a second magnetic field—a gradient field—whose strength depends on its location. This leads to a linear variation in resonance frequency. Thus you can work out the location from which the resonance signal was sent. Through a suitable combination of three mutually perpendicular gradient fields you can divide objects up into layers and represent these layers in two or three dimensions on the screen with high spatial resolution—and this makes it possible to take a "walking tour" through the object of investigation.

Medical diagnosis works similarly in so-called nuclear spin tomography. Doctors are particularly fond of the fact that the magnetic field penetrates into the inner layers of the body—thus they can reach organs lying much deeper than with ultrasound, for example. But unlike X-rays, this technique does not damage the body.

The magnetic fields used in medicine are not as strong as those used in NMR microscopy. The result is lower resolution. But the microscopic standard is not even required if the doctor simply wants to know whether his patient has a brain tumor or not.

But the requirements of the scientist who wishes to investigate new materials or individual cells are different. In order to make every detail visible, a further unit of measurement is brought into play in NMR microscopy, the so-called relaxation time. What this means is the time which the unbalanced top requires before it returns to the perpendicular. And that depends not only on the type of atom and the immediate chemical environment in the individual molecule, but also on other physical properties of the substance, particularly the mobility of the molecule. The atoms of solid bodies or viscous fluids—including polymers and most biomolecules—need much longer, for example, to return to the original state after a disturbance. Skilful play with the relaxation time is particularly important when the mobility of the molecules in a sample, for example of tire rubber, changes on the basis of aging processes—for the older a rubber is, the more strongly the chainlike components are interlocked. These processes can be localized with NMR microscopy and both qualitatively and quantitatively described. The first projects to achieve this were undertaken in 1990 in the IBMT under the direction of Dr. Winfried Kuhn. The objective was the translation of NMR relaxation times into material identification measures on the basis of physical theories which describe molecular movements in interlocked polymers. This has now been achieved: how strongly and how homogeneously the molecules are interlocked can be determined individually for every location and thus a statement can be made about the quality of the vulcanization process. Since then the results of these projects, which are supported by the German Research Association and by industry, have met with international acclaim and have been documented in numerous publications.

The frequencies with which resonance is measured lie approximately in the range of radio waves, and thus are not harmful to cells or tissue. The fact that the waves also penetrate deeply into an object makes them interesting for applications in the material sciences as well as for biomedical research. Whenever the problem involves the distribution of components in an inhomogeneous mixture, NMR microscopy is the analytical method of choice. For example, the location of toxic substances in wood becomes just as evident as the distribution of water and other solvents in polymers, or that of glass fibers in epoxy resin. Since the samples can be taken and evaluated in real time, diffusion processes can also be followed—for example, how ethanol and water mix.

In contrast to the traditional preparation of an object for a microscopic photograph, NMR technology is nondestructive. This makes it possible to follow a process over a longer period. In addition, doctors can use measurements taken over several weeks to observe how the blockage in an artery is being dissolved using a certain treatment, or how a tumor grows over time. And materials scientists also stand in need of extended-time application of NMR microscopy: how else could they follow a gradual process like the growth of a crack or the corrosion of a tool nondestructively?

The most important factor in the quality of a microscopic investigation is its resolution: IBMT researchers have achieved consistent improvement in this area over the last few years. At this point a "voxel," a picture element which is clearly distinguishable in space from its neighbor, measures a mere 5x5x50 micrometers. But this requires a magnetic field which is at least 100,000 times as strong as the earth's magnetic field. Only spools of superconducting material can generate such strong fields. The high resolution is required in particular when the objective is to investigate biological structures in detail. Apart from botanists, who can now finally complete the picture of the distribution of substances within plants, the main beneficiary of NMR microscopy is basic medical research.

This method requires the development of highly sensitive sampling heads. In addition, image evaluation requires special software. Both are being developed for the many applications of NMR microscopy, from materials research to biomedicine, in Winfried Kuhn's working group.

Sampling heads are highly specialized antennae for frequencies of 12 MHz to 750 MHz, with which samples with a diameter of up to about 25 mm can be measured. A technologically significant application is the localized investigation of chemical reactions in a catalytic converter using ^{13}C spectroscopy under normal running conditions. Thus for the first time it was possible to observe the course of the reactions and the aging of catalytic converters in real time at temperatures of approximately 400°C and at high pressure; these experiments were conducted under contract to a large European petrochemical company.

So it is worthwhile to listen carefully to the music of the atomic nuclei, and such listening will enrich medicine, the material sciences and technology.

TELECOMMUNICATIONS

EUREKA European Digital Television Project Started

MI1310114494 Turin MEDIA DUEMILA in Italian Sep 94 p 48

[FBIS Translated Text] The high definition project has been abandoned, and Europe is concentrating on numerical technologies with the EUREKA [European Research Coordination Agency] 1187 ADTT [Advanced Digital Television Technologies] that has a budget of 500 billion lire over two and a half years.

Brussels. Europe is trying again and is back on the starting blocks in the race to produce the television of the year 2000. It has abandoned the high definition track and taken the digital road. The new EUREKA television project, EUREKA 1187 ADTT, launched at Lillehammer by the ministerial conference of the organization for European research, will have the results of the EUREKA 95 project for high definition television at its disposal, and is concentrating on the advanced numerical technologies from which it takes its name.

The EUREKA 1187 ADTT project has a budget of 260 million ECU's (about 300 million dollars, almost 500 billion lire), over a period of two and a half years. The initial participants are Philips, Thomson Consumer Electronics, Nokia, Bang og Olufsen, the BBC [British Broadcasting Corporation], Spanish television and other Spanish industries, and the CISAE (a consortium that represents a number of Italian participants); however, more than 35 other partners have already announced that they intend to participate.

The goal of the ADTT project is to enable European industry to prepare itself for the rapid assertion of numerical television broadcasting technologies. The project will cover the basic technologies of production, transmission, and reception, and the equipment for taking television pictures and projecting them. The project also has the goal of adapting itself to all the technological developments that may take place on an international level.

EUREKA 1187 is availing itself of the results that were obtained by EUREKA 95 when Europe was trying to fight a world standards "war" with Japan. In the meantime the United States has withdrawn from the high definition competition. However, it does not want to repeat errors, and is avoiding encounters with "cosmic religions" on world standards, preferring to try to keep itself as close as possible to the market, and thus to the consumers.

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As far as organization is concerned, a steering committee has been created that includes members from Philips, Thomson, Nokia, CISAE and a British consortium. The committee directs and manages the project with the assistance of a staff of professionals, the project office. The steering committee meets regularly to discuss the progress of the project, acting as an interface for contacts between the groups working on the project, and looking after the technical, economic, and planning aspects together with the group leaders.

Five work groups are responsible for the specific areas of research and development; systems integration, key technologies for consumer applications, studio equipment, applications not destined to the broadcasting of programs, and evaluation.

The launching of EUREKA 1187 is a confirmation of Europe's commitment to keep in step with developments in the television sector and, more in general, in the audiovisual sector, as far as both the industrial and the cultural aspects are concerned. To lose control of the instruments of production and broadcasting could mean, on the threshold of the new century, condemning oneself to be subjected to a technological "colonization," followed by an economic one, in a key sector for keeping and exalting the continental identity. The recent initiatives to launch a European audio visual policy should be looked at from this point of view, putting together the interests of the producers, the program distributors, and of those who make use of them.

While the new offensive gets started, the projects that have already been mapped out are going ahead. The European commission has published an announcement in the *GAZZETTA UFFICIALE* inviting radio broadcasters and program producers to present their requests for financial contributions for the production of programs, regarding programs produced in, or converted into, the 16/9 format, putting into effect the plan of action for the introduction of advanced television services in Europe. The final date for the acceptance of proposals is September 15. Those interested should request detailed instructions for the presentation of the request to the European commission (Mr. Gregory Paulger, General Directorate X/C/3, T120 3/3, rue de la Loi 200, 1049 Brussels, fax (00322) 299 9201). This will probably be the last invitation to present proposals for funding from the community budget for 1994.

European Network Market Expected to Increase 45 percent by 1997

95WS0006C Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 29 Sep 94 p 8

[Article entitled: "Ovum Predicts 10 Billion ECU Turnover in Europe in 1997"]

[FBIS Translated Text] Frankfurt. Ovum Ltd., a British market analysis company, predicts that the European

value-added network services market may reach a turnover of 10.5 billion ECU in 1997. This amount would represent a 2.50-percent increase over 1992. For the most part, the growth is the result of the further development of various geographic markets as well as of advances in wide area E-mail and wide-band services.

Although the market is still dominated by data network services like the public X.25 Services and Managed Data Network Services, their market share is falling. In 1992, 66 percent of the entire turnover was attributed to data network services. Ovum predicts that, despite the fact that the data network services continue to dominate the market, their share of the market will drop to 45 percent by 1997. This predicted trend is the result of the increasingly slower development of X.25, which is being replaced by wide-band services.

Between 1993 and 1997, electronic mail will move up to second position from its sixth market-share position today. The main reason for its growth is attributed to its transportability to the X.400 base and the increased use of wide area E-mail. To a considerable degree, fax and enhanced fax traffic will also be replaced by E-mail.

France will remain Europe's largest components market. France's large share in this market turnover stems from Transpac—her comprehensive public packet data network, which has also taken over the Teletel Video Text Services for the Minitel terminals. Both Transpac and Teletel enjoy generous support from the French Government—an important factor in their continued success.

Elisa Seminari and Clare McCarthy (Ovum Ltd., 1 Mortimer Street, London WIN 7RH, England/Fax +44(0)71255) report that the permanent information service VANS Markets Europe contains Ovum forecasts dealing with eight different value-added data network markets in nine countries, profiles of the 50 leading producers in Europe, and the special features of the various markets.

Germany: Computer Network To Link Cottbus University

MI1310103994 Bonn TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN in German 30 Aug 94 pp 3-4

[FBIS Translated Text] As part of its "Telecooperation—Added Value Services" priority research project, the BMFT [Federal Ministry for Research and Technology] is funding the project at the Cottbus Technical College entitled "R&D Capacities in the New German Laender" for setting up an innovative PC-supported information network.

It will make a comprehensive and reliable survey of the profiles of the research and development potential in the new German laender, in the first instance, so that this can be made available quickly and easily to interested parties.

This extremely modern service will be distributed over various routes—online via the normal telecommunications network, in printed form, or on CD-ROM. When the planned information network is built up, constantly updated data on R&D organizations and individual scientists will then be available in an easy-to-use form to a broad range of interested parties.

In conjunction with this supportive measure for the R&D potential of the new German laender, a new type of method is being created for setting up and operating modern added-value services in which data are acquired, processed, controlled for quality requirements and supplied on the basis of modern telecommunications. The goal of the research project is to provide a better and cheaper alternative to the methods used so far in terms of its scope and cost. The intention is that the results can be used as a model for setting up information systems for other application areas and innovative added-value services.

The planned service will offer institutions and companies that carry out research and development the opportunity for the first time to be "fully" integrated in a comprehensive information system with the minimum technical outlay. That means that interested R&D establishments and scientists themselves can easily be a part of this network without having to go via circuitous routes, in contrast to existing systems.

User-friendly modules will enable interested parties to enter and call up data into and from the information system via telephone, Datex-J, ISDN [Integrated Services Digital Network], among other routes.

It will be possible for the various components of the added-value service (information service, mailbox for information exchange) to be used via a number of access routes such as PC host or as a printed service.

The resulting network will also offer participants the opportunity to influence the content and form of the planned added-value service themselves. This would also be possible by means of a dialogue via mailbox. A "living" network of suppliers and users of R&D services

will therefore be created and, in the medium term, an "electronic market place" for science and research throughout Germany and beyond.

Apart from Cottbus Technical College, Department of Production Economics, the Institute for Information, the Federation of Innovative Enterprises e.V. in Dresden, and the Infoware Association for Information Technology Ltd. from Cologne are taking part in the project. The Federal Ministry of Research and Technology is supporting this pilot project from 1994 to 1996 with funds of 1.7 million German marks.

Further information can be obtained from Dr. G. Warmer, information technology project leader of the BMFT at the German Research Institute for Aerospace [DLR], Linder Hoehe, 51147 Cologne, tel. 02203/6013332, fax 02203/6013017.

Germany: Small Chip Improves Handheld Telecommunications

95P6004A Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 21 Sep 94 p 8

[FBIS Translated Text] This new chip from the Munich-based Siemens Laboratory functions within a small space. For the first time all components needed for high-frequency sending and receiving, except the antenna, are combined on 25 square millimeters—[at this size] it just fits a soda straw opening. Because of this it will be possible in the future to build mobile telephones, the internal components of which consist of only two chips. Terminal equipment would then be lighter, more efficient, and less expensive. At present, the send and receive parts of so-called "handhelds" occupy a surface of approximately 10-20 square centimeters. Several hundred components, such as filters, coils, and integrated circuits, are mounted on this surface. The new chip now uses only transistors—about 1,500—for all its functions. Integration on this level was very difficult, since interaction and coupling effects frequently result when different electronic components work together in a small space at operating frequencies in the gigahertz range.

COMPUTERS

Israel: New Chip Developed for Parallel Computing

94WS0526C Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 16 Sep 94 p 8

[Article by toz: "High-Capacity Parallel Working Microprocessor"]

[FBIS Translated Text] Frankfurt—While all parallel-processing computer systems have been equipped with many individual microprocessors on several printed boards, Israeli electronics engineers have now been able to develop a chip which alone takes over the task of the processors. The engineers have thus succeeded in doing something which, with major financial support, it has not so far been possible to do in the United States and Japan.

The new parallel chip, which the ASP Solutions company in Raanana will produce and market under the name Xium, consists of 1,024 individual cells, which optionally can work either as processors or as storage cells. Each of the individual processors on the chip, as a further innovation in concept, thus has a memory of its own available to it. All cells work coordinated in a parallel mode and can therefore process much larger amounts of data at speed not previously achieved.

It will thus be possible to do, for example, video color pictures, multimedia or three-dimensional image processing, including the "morphological" differences, in nearly real time. The clock speed of the chip is 15 megahertz. This makes it possible to achieve 600 MIPS (Million Instructions Per Second) computing power during video processing, 400 MIPS three-dimensional real-time video pictures and 200 MIPS mathematical encoding. The computing power is most notable for pattern recognition, which can be brought to 15,000 MIPS.

As in the construction of the previously built parallel computers, several of the chips can be combined with one another to increase computing capabilities and speeds. In order to quadruple the computing speed, for example, four Xium chips can be switched together in parallel. Evaluations reveal that with this combination up to 60,000 MIPS could theoretically be achieved.

Because of the high pattern recognition speed, the developers intend to make Xium systems available first to banks for recognizing signatures. Furthermore, contact has been made with North American cable television companies, which, using the new parallel computer system, can "switch" video films selectively to their customers (pay TV on demand). Additional application areas are new types of encoding and deciphering systems, which can work considerably faster and in which military technologists have announced their interest.

The computing achievements so far reported were worked out with existing software programs for parallel computers. Whether there will be additional improvements depends essentially on the software used, which to begin with, despite the Xium, will remain the bottleneck for the use of all "massively" parallel-working systems. It is conceivable, however, that working with inexpensive Xium systems software engineers will now be able to develop new software program faster. Additional information: ASP Solutions, Ltd., Raanana 430100 Israel.

NUCLEAR R&D

Brazil University Gains Know-How From Nuclear Sub Work

95WS0002A Sao Paulo GAZETA MERCANTIL in Portuguese 11 Aug 94 p 13

[Article by Thereza Martins]

[FBIS Translated Text] Sao Paulo—In 1988, the Institute of Electrotechnology and Energy (IEE), affiliated with Sao Paulo University's [USP] Polytechnical School, began developing a prototype for the propulsion motor of the nuclear submarine that the Brazilian Navy wants to construct by the first decade of the year 2000. This is a new generation motor, fed by a transistorized electronic converter, controlled by microprocessors and computer-activated. Six years later, with the project completed, the IEE is still accruing dividends from this effort.

"The success of the undertaking may be gauged by the prototype's excellent performance, the various publications generated on the national and international level, the doctoral and master's theses on the subject, and the contribution that it has been, and still is making to electrical engineering education at the USP's Polytechnical School." This assessment was made by Professor Orlando Silvio Lobosco, director of the IEE's power area, who has followed the project since the early days of the work.

This September, Professor Lobosco will be in Paris, accompanied by another engineer associated with the project, to present results of scientific studies and research on the prototype at the International Conference on Electrical Machines (ICEM 94). This is an important event for the sector, with participation by international research institutions and business firms.

Resources

The project, sponsored by the Ministry of Navy and the Funding Authority for Studies and Projects (FINEP), has turned over more than \$1.5 million from the initial phase, involving research and travel, to that of the purchase and development of equipment. Lobosco claims: "The USP has benefited from this work as well, especially in terms of equipment and the development of its personnel."

Since this is an endeavor resulting from the merger of leading edge technologies, the prototype gathered professionals from various fields, such as electrical engineering, electronics, and structural and control mechanics. Now, this accumulated information and the technology developed are at the disposal, not only of other universities, but also of the industry.

The type of motor developed as a prototype for the Navy has multiple applications. In the naval sector, it can be used to propel ice breakers and other vessels. Owing to the excellent performance achieved in low-speed tests, the motor also may be used to activate cement or ore grinders, in the paper and cellulose industry, and in mine elevators.

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